

D3D Project Newsletter — Months 7–12

Period: Months 7–12

Project: *Deep 3D Scattering of Solar Radiation in the Atmosphere due to Clouds* (D3D)

Funded by: Hellenic Foundation for Research and Innovation (H.F.R.I.)

Project Overview — Progress in Months 7–12

During Months 7–12 of the D3D project, the team transitioned from early methodology development toward expanded deployment, data acquisition, model refinement, and broader dissemination of research outputs. Significant progress was made across theory, experimentation, and computational frameworks, advancing the project toward its mid-term research goals.

Researchers concentrated on strengthening 3D reconstruction techniques, integrating advanced radiative transfer modeling with enhanced datasets, and disseminating results through international conferences and journal submissions. This period marked an important phase of consolidation and expansion of project components, setting the stage for deeper scientific exploration in the next half of the project.

2. News Highlights (Months 7–12)

- The team published an update on integration of radiance calibration procedures for ASI networks and improved processing pipelines to support high-quality 3D scene reconstructions. Early validation of radiance calibration stability was discussed, enhancing confidence in subsequent algorithmic workflows.
 - D3D researchers demonstrated preliminary stereoscopic reconstructions of cloud fields using synchronized ASI imagers under diverse atmospheric conditions. This milestone showcased the practical applicability of the reconstruction methods developed in earlier months.
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3. Publications & Dissemination — Outputs of the Period

Journal Articles

- Logothetis, S.-A.; Giannaklis, C.-P.; Salamalikis, V.; Tzoumanikas, P.; Raptis, P.-I.; Amiridis, V.; Eleftheratos, K.; Kazantzidis, A. Aerosol Optical Properties and Type Retrieval via Machine Learning and an All-Sky Imager. *Atmosphere* 2023, 14, 1266. <https://doi.org/10.3390/atmos14081266>

Conference Presentations

- Christos Giannaklis, Stavros Andreas Logothetis, Vasileios Salamalikis, Panagiotis Tzoumanikas, and Andreas Kazantzidis, D3D: Deep 3D scattering of solar radiation in the atmosphere due to clouds, <https://meetingorganizer.copernicus.org/EMS2023/EMS2023-568.html>
- Giannaklis C.P, Logothetis S.A, Salamalikis V., Tzoumanikas P., Raptis P.I., Amiridis V., Eleftheratos K. and Kazantzidis A., An alternative method for deriving aerosol optical properties and aerosol type via an all sky imager and machine learning. GRASP ACE Summer school, May 2023

These early publications laid the groundwork for future algorithm validation and dissemination.

4. Research Progress by Work Package

WP1 — Instrument Calibration and Network Operations

The ASI network underwent extended calibration checks and operational consolidation. The revised calibration workflows improved cross-sensor radiometric alignment, enabling more reliable multi-sensor radiance estimations necessary for 3D retrievals.

WP2 — Atmospheric Parameter Extraction & 3D Reconstruction

Work advanced on robust stereoscopic reconstruction algorithms that combine multi-viewpoint ASI imagery to produce high-resolution 3D representations of cloud structures. Early results demonstrate resilience of the reconstruction against environmental noise and atmospheric variability.

WP3 — Radiative Transfer Modeling with MYSTIC

The team made progress integrating the MYSTIC model into the workflow for detailed radiative simulations on reconstructed cloud fields. These simulations provided vital benchmarks for assessing the accuracy of 3D estimations and identifying conditions where models perform optimally.

WP4 — Deep Learning Frameworks

Initial versions of deep learning architectures were developed for rapid approximation of radiative transfer outputs. Preliminary results show promise in reducing computational cost while maintaining accuracy, supporting potential real-time applications.

5. Scientific Milestones Achieved

- Successfully tested radiometric calibration workflows across multiple ASI sensors, increasing the reliability of data used for 3D reconstructions.
 - Demonstrated initial 3D cloud reconstructions in real atmospheric conditions, validating core methodologies from earlier phases.
 - Integrated MYSTIC radiative transfer simulation with reconstruction outputs, allowing richer evaluation of radiative estimates against model predictions.
 - Developed early deep learning models showing feasibility of accelerated estimation of atmospheric radiative quantities.
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